78(3): Effect of Gravitation on the IFE and the Plasma Cosmology.

We start with the wave equation:

$$\left(\Box + kT \right) q_\mu^a = 0. \quad — (1)$$

When there is no gravitational effect:

$$kT \rightarrow \left(\frac{mc}{\hbar} \right)^2 \quad — (2)$$

and we obtain the Dirac equation:

$$\left(\Box + \frac{m^2c^2}{\hbar^2} \right) q_\mu^a = 0. \quad — (3)$$

Using the equivalence rule:

$$p^\mu = i\hbar \partial^\mu \quad — (4)$$

we obtain the Einstein equation:

$$p^\mu p_\mu = m^2 c^2. \quad — (5)$$

Using the minimal prescription:

$$p^\mu \rightarrow p^\mu - eA^\mu \quad — (6)$$

we obtain the relativistic Hamilton Jacobi eqn.

$$\left(p^\mu - eA^\mu \right)\left(p_\mu - eA_\mu \right) = m^2 c^2. \quad — (7)$$

We now need to incorporate the effect of gravity into eqn. (7).

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This is done using eqn. (2), so:

$$m^2c^2 \rightarrow \hbar^2 kT \quad -(8)$$

and

$$\boxed{m \rightarrow \left(\frac{\hbar}{c} k^{1/2}\right) T^{1/2}} \quad -(9)$$

So m is replaced wherever it occurs in the following equations of the IFE by the quantity on the RHS of eqn. (9):

$$v_x = \frac{ec}{m\omega} B^{(0)} \cos\omega t, \quad v_y = -\frac{ec}{m\omega} B^{(0)} \sin\omega t,$$

$$r_x = -\frac{ec^2}{\gamma\omega^2} B^{(0)} \sin\omega t, \quad r_y = -\frac{ec^2}{\gamma\omega^2} B^{(0)} \cos\omega t$$

$$\gamma = mc\left(1 + \left(\frac{eB^{(0)}}{m\omega}\right)^2\right)^{1/2},$$

$$\Omega = \left(\omega^2 + \frac{e^2 B^{(0)2}}{m^2}\right)^{1/2},$$

$$\theta = \tau\Omega,$$

$$\underline{J} = \frac{e^2 c^3 B^{(0)2}}{\gamma\omega^2} \underline{k}.$$

) Limits

1) If $\omega << \frac{eB^{(0)}}{m}$,

$$\underline{J}^{(3)} \rightarrow \frac{ec^2}{\omega^2} \underline{B}^{(3)}$$

and $$\boxed{\theta \rightarrow \tau \frac{eB^{(0)}}{m}} \quad -(10)$$

2) If $\omega >> \frac{eB^{(0)}}{m}$,

$$\underline{J}^{(3)} \rightarrow \frac{e^2c^2}{m\omega^3} B^{(0)} \underline{B}^{(3)}$$

and $$\boxed{\theta \rightarrow \tau\omega} \quad -(11)$$

It is seen that in the high frequency limit (11) the hyperbolic spiral is unaffected by gravitation. Therefore the spiral arms of a galaxy are not affected by gravitation. This is as observed. In the opposite low frequency limit, θ is affected by gravitation:

$$\boxed{\theta \rightarrow \frac{\tau e c B^{(0)}}{k k^{1/2} T^{1/2}}} \quad -(12)$$

4) Resonance Frequency of RFR

For an electron this is:

$$\omega_{res} = \frac{e^2 c^2}{2m\omega^2} B^{(0)2} \quad -(13)$$

giving:

$$f_{res} = \left(\frac{e^2 \mu_0 c}{2\pi \hbar m} \right) \frac{I}{\omega^2} \quad -(14)$$

This is changed by gravitation to:

$$\boxed{f_{res} = \left(\frac{e^2 \mu_0 c^2}{2\pi \hbar^2 k^{1/2} T^{1/2}} \right) \frac{I}{\omega^2}} \quad -(15)$$

The RFR resonance frequency can be estimated to great accuracy using contemporary experimental methods, so should be affected by gravitation.

Similarly, synchrotron and pulsar radiation should be affected by gravity.

Eq (15) is:

5)

$$f_{res} = \left(\frac{e^2 \mu_0 c^2}{2\pi \hbar^2 k^{1/2}} \right) \frac{1}{T^{1/2}} \frac{I}{\omega^2} \quad -(16)$$

and the quantity in brackets is all made up of fundamental constants. Here I and ω are the intensity and angular frequency of the pump beam. So the only parameter is:

$$T = -R / k \quad -(17)$$

which is <u>the canonical energy momentum density of the gravitational field.</u> In the limit where the gravitational field has no influence:

$$T \rightarrow m / V. \quad -(18)$$

In this limit there is no influence of gravitation on a fermion or photon. Otherwise T must be calculated from a metric and the correct Cartan geometry. Eq (5) is the Einstein equation of <u>special</u> relativity, in which there is no gravitation present.